Austin Transit Partnership

Austin Transit Partnership

Austin Light Rail Phase 1 Project

Air Quality and Greenhouse Gases Technical Report

Austin, TX

January 2025

Contents

Tables

Figures

Attachments

Acronyms and Abbreviations

Term/Acronym	Definition
°F	degrees Fahrenheit
μg/m³	microgram per cubic meter of air
Austin MSA	Austin-Round Rock-Georgetown Metropolitan Statistical Area
ATP	Austin Transit Partnership
CAMPO	Capital Area Metropolitan Planning Organization
CAPCOG	Capital Area Council of Governments
CapMetro	Capital Metropolitan Transportation Authority
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	greenhouse gas
NAAQS	National Ambient Air Quality Standards
NOAA	National Oceanic and Atmospheric Administration
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
Project	Austin Light Rail Phase 1 Project
STOPS	Simplified Trips-on-Project Software
TCEQ	Texas Commission on Environmental Quality
TxDOT	Texas Department of Transportation
VMT	vehicle miles traveled

1 Introduction

The Federal Transit Administration (FTA) and Austin Transit Partnership (ATP) are completing an environmental review of the Austin Light Rail Phase 1 Project (the Project) in Austin, Texas. This air quality and greenhouse gases technical report was prepared to support the Project's Draft Environmental Impact Statement in accordance with the National Environmental Policy Act and related laws and regulations. FTA and ATP are the Lead Agencies in the National Environmental Policy Act process.

This report assesses the potential local and regional effects on air quality that would result from the construction and operation of the Project. The Project would reduce traffic volumes in the Study Area and vehicle miles traveled (VMT) in the region, and when compared to the No Build Alternative, the Project would result in an overall improvement in air quality. Direct[1] construction emissions would be temporary. The light rail vehicles are electrically powered with no direct operational emissions. However, train and station power consumption of electricity from the electric grid would contribute to greenhouse gas (GHG) emissions at power plants; these are known as upstream GHG emissions.

This report:

- summarizes regulations governing transportation projects and reviews ambient air quality in the region;
- qualitatively explains why substantial adverse effects on regional and local air quality would not be expected to occur under the Build Alternative and the Design Options;
- addresses the indirect effects of GHG emissions at power plants in accordance with FTA guidance; and
- identifies construction best management practices that would be used to reduce dust and emissions during construction.

There would be nominal differences between the Build Alternative and the Design Options because the VMT reduction would be similar in all cases. The Study Area for air quality and GHGs is the Austin-Round Rock-Georgetown Metropolitan Statistical Area (Austin MSA).[2] The Austin MSA is the air quality control region defined by the U.S. Environmental Protection Agency (EPA) to monitor the attainment or nonattainment of the federal air quality standards.

[1] Direct emissions, also referred to as downstream emissions, are those caused by the transit project and occur at the same time and place, such as tailpipe emissions generated during the construction of the project. Indirect emissions, referred to as upstream emissions, are those that occur later in time or farther removed in distance from the proposed transit project, such as extracting, processing, refining, and transporting of the fossil fuel used for construction or to power the transit vehicles.

[2] The Austin MSA consists of Bastrop, Caldwell, Hays, Travis, and Williamson Counties, which have been participating in regional air quality planning efforts since 2002. This MSA is also referred to as the Austin-Round Rock-San Marcos MSA.

2 Regulatory Setting

2.1 The Clean Air Act and its Amendments

Air quality in the United States is regulated by the Clean Air Act of 1970 (42 United States Code 7401 et seq.) and its 1990 amendments, which are administered by EPA. The Clean Air Act establishes federal policy “to protect and enhance the quality of the nation’s air resources” to protect human health and the environment (42 United States Code 7401(b)). The Clean Air Act requires that adequate steps be taken to control the release of air pollutants and prevent substantial deterioration in air quality. The 1990 amendments require federal agencies to determine the conformity of federally funded proposed actions with respect to State Implementation Plans for attainment of air quality goals.

Regulations implementing the Clean Air Act established primary and secondary National Ambient Air Quality Standards (NAAQS) as a basis for assessing air quality. Primary standards set limits to protect public health, including the health of children, the elderly, and asthmatics. Secondary standards set limits to protect public welfare, which includes damage to animals, crops, vegetation, and buildings. EPA regulates air quality in accordance with the primary and secondary NAAQS. The NAAQS currently regulates six criteria pollutants under the primary standards: carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Particulate matter standards are further defined into a standard for particulate matter smaller than 10 microns in diameter (PM_{10}) and for particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$). **Table 1** summarizes NAAQS related to the six criteria pollutants.

EPA delegates authority to the Texas Commission on Environmental Quality (TCEQ) for monitoring and enforcing air quality regulations in the State of Texas. TCEQ monitors specific air pollution levels at 18 air-monitoring stations throughout the Austin MSA. The Texas State Implementation Plan, developed in accordance with the Clean Air Act, contains the major state-level requirements for transportation. TCEQ is responsible for preparing the State Implementation Plan and submitting it to EPA for approval.

Transportation conformity regulations in 40 Code of Federal Regulations Part 93, Subpart A, and general conformity regulations in 40 Code of Federal Regulations Part 93, Subpart B, apply only in areas that do not meet or previously have not met air quality standards for carbon monoxide, nitrogen dioxide, PM_{10}, $PM_{2.5}$, and ozone (40 Code of Federal Regulations Part 93, Subpart A). The Austin MSA, which includes Travis County, is in attainment for all NAAQS criteria pollutants; therefore, the transportation conformity and general conformity regulations do not apply to the Project.

Table 1: National Ambient Air Quality Standards

Pollutant	Primary Standard	Average Times	Secondary Standards	Notes
Carbon monoxide (CO)	9 ppm (10 mg/m^3)	8-hour	None	Not to be exceeded more than once per year
	35 ppm (40 mg/m^3)	1-hour	None	
Lead (Pb)	0.15 µg/m^3	Rolling 3-month average	Same as Primary	Not to be exceeded
Nitrogen dioxide (NO_2)	100 ppb (0.100 ppm)	1-hour	None	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	53 ppb (0.053 ppm)	Annual (arithmetic mean)	Same as Primary	Annual mean
Particulate matter smaller than 10 microns in diameter (PM_{10})	150 µg/m^3	24-hour	Same as Primary	Not to be exceeded more than once per year on average over 3 years
Particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$)	New standard: 9 µg/m^3 [old standard: 12 µg/m^3]	Annual	15 µg/m^3	Annual mean, averaged over 3 years
	35 µg/m^3	24-hour	Same as Primary	98th percentile, averaged over 3 years
Ozone (O_3)	0.070 ppm	8-hour	Same as Primary	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Sulfur dioxide (SO_2)	75 ppb (0.075 ppm)	1-hour (primary) 3-hours (secondary)	0.5 ppm	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	None	3-hour	0.5 ppm (1300 g/m^3)	Not to exceed more than once per year

Source: EPA 2023a.
µg/m3 = micrograms per cubic meter; g/m3 = grams per cubic meter; mg/m3 = milligrams per cubic meter; ppb = parts per billion; ppm = parts per million

On February 7, 2024, EPA announced a final rule to strengthen NAAQS for fine particle pollution, also known as fine particulate matter ($PM_{2.5}$) or soot (EPA 2024a). Fine particles can be emitted directly from sources such as vehicles, smokestacks, and fires. Fine particulate matter can also form when gases emitted by power plants, industrial processes, and gasoline and diesel engines react in the atmosphere (EPA 2024a). EPA set the level of the primary, health-based, annual $PM_{2.5}$ standard at 9.0 µg/m^3 (microgram per cubic meter of air) to reflect new science on harms caused by fine particle pollution. The EPA concluded that the revised annual standard together with the current 24-hour standard will protect public health with an adequate margin of safety. EPA is also finalizing revisions to other key aspects related to the particulate matter NAAQS, including revisions to the ambient monitoring requirements for particulate matter, to focus on at-risk communities—to include environmental justice communities—and the Air Quality Index (AQI). EPA will be working to designate areas based on whether they meet the revised $PM_{2.5}$ standard. EPA will designate all areas of the country as attainment (meeting the standards), nonattainment (not meeting the standards), or unclassifiable (not enough data to make a determination). This process is referred to as initial area designations. All areas designated as nonattainment will be initially classified as "Moderate." If an area does not attain the NAAQS by the Moderate attainment date (6 years from designations), then the area is reclassified to "Serious," must meet additional planning requirements, and has a new attainment date of 10 years from designations. Those areas that do not meet the revised $PM_{2.5}$ NAAQS will need to develop plans that demonstrate how they will meet the standards.

2.2 Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are NAAQS, EPA also regulates air toxics; most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), and stationary sources (e.g., dry cleaners, factories, refineries). Air toxics are pollutants that cause or may cause cancer or other serious health effects, such as reproductive disorders (reduced fertility), damage to the immune system, neurological and developmental disorders, respiratory disorders, and other health problems. Air toxins may also cause adverse environmental and ecological effects. Mobile source air toxics are compounds, such as benzene and other hydrocarbons, emitted from highway vehicles and non-road mobile source engines (e.g., heavy construction equipment, trains, ships) that are known or suspected to cause cancer and other serious health and environmental effects. Under the Clean Air Act, EPA identified 188 air toxics labeled as hazardous air pollutants, which include mobile source air toxics and nine priority mobile source air toxics that EPA has identified as national- and regional-scale cancer risk drivers. These priority mobile source air toxics are acetaldehyde, ethylbenzene, benzene, formaldehyde, naphthalene, diesel particulate matter and diesel exhaust gases, acrolein, 1,3-butadiene, and polycyclic organic matter. Currently, there are no established health-based air quality standards for mobile source air toxins.

2.3 Greenhouse Gases

GHGs include carbon dioxide, methane, water vapor, nitrous oxide, and fluorinated gases such as chlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. A common unit of measurement for GHGs is metric tons of carbon dioxide equivalent. Two of the largest contributors to GHG emissions in the United States are transportation and electricity production. As of 2021, the transportation sector generates the largest share of GHG emissions, accounting for approximately 28 percent of GHG emissions in the United States; electricity production contributed 25 percent (EPA 2023b). GHG emissions from transportation sources are directly related to energy consumption and primarily result from the combustion of fossil fuels in vehicles. Over half of the GHG emissions from transportation sources come from passenger cars and light-duty trucks, including sport utility vehicles, pickup trucks, and minivans. The remainder of the GHG emissions come from other modes of transportation, including freight trucks, commercial aircraft, ships, boats, and trains, as well as pipelines and lubricants.

There are a variety of opportunities to reduce GHG emissions associated with transportation. These include reducing engine idling, reducing demand travel (e.g., mixed-use zoning, active and public transportation), improving fuel efficiency by leveraging technology, and switching to renewable alternative fuels (e.g., electric, compressed natural gas, renewable natural gas). FTA has responded to the need to reduce GHG emissions by creating new funding programs to (1) purchase low carbon emitting vehicles, (2) convert fleets to electric buses, (3) make facilities more energy efficient, (4) generate power through renewable energy sources, and (5) conduct research on strategies to reduce transit emissions. FTA also developed the Transit Greenhouse Gas Emissions Estimator, which allows agencies to estimate the partial lifecycle GHG emissions generated from the construction, operations, and maintenance phases of projects. However, use of this tool is not mandatory and is not warranted for projects that would have the overall beneficial effect of reducing emissions when considering all project phases.

3 Methodology

The air quality analysis methods and calculations discussed in this technical report follow the *Capital Investment Grants Policy Guidance* (FTA 2023a) and the *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment* (FTA 2024). Direct energy was calculated based on the VMT data provided by FTA's Simplified Trips-on-Project Software (STOPS) travel demand model, using data inputs from the Capital Area Metropolitan Planning Organization (CAMPO) for both the No Build and Build Alternatives. The factors used to determine the reduction in emissions were derived from the New Starts Template (FTA 2023b). The affected environment in the Austin MSA is described based on monitoring data for NAAQS pollutants, reviewing meteorological conditions affecting local air quality, and summarizing air quality trends. As indicated in Section 2, because the Project is located in an air quality attainment area, quantitative hot spot and conformity analyses are not required.

The Project would include the construction of an 9.8-mile light rail track (1.08-mile elevated Design Option) with 15 stations, a catenary system, vehicle parking areas, utilities, guideway maintenance, light rail vehicle operations, and operating and maintenance facilities; its operations would displace automobile VMT. FTA's *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment Report 0263* indicates that light rail projects with a high proportion of displaced VMT to annual transit VMT, regardless of length, alignment, and number of stations, are expected to result in a net reduction in GHG emissions (FTA 2024). Similar to the FTA Programmatic Assessment sample projects that result in relatively high rates of displaced automobile VMT, the Project would displace approximately 10.98 million automobile VMT per year. Therefore, the Project is expected to result in a net reduction of GHG emissions similar to the light rail sample projects in FTA's Programmatic Assessment. **Table 2** shows a comparative summary of the Project and the sample projects used in the FTA Programmatic Assessment (FTA 2024). As shown in **Table 2**, sample light rail projects similar to the Project would result in net reduction in GHG emissions. As such, the FTA Programmatic Assessment's analysis and findings of light rail construction, operations, and maintenance [upstream and downstream] GHG emissions are incorporated by reference (FTA 2024).

Table 2: Comparison of the Project and FTA Report 0263 Light Rail Scenario GHG Emissions Analysis Results

Project	Guideway Mileage			Number of Stations		Number of Parking Spaces		Annual Transit VMT	Annual Displaced VMT	Total Annual Emissions in $MTCO_{2}e$
	Above	Below	At-Grade	Above	At-Grade	Surface	Structure			
Austin Light Rail Phase 1 Project	**1.08**	**-**	**9.8**	**1**	**15**	**300**	**300**	**854,645**	**(20,138,525)**	**(Net Reduction)**
LRT 1	3	0.5	11	-	16	2,731	-	2,956,782	(30,273,965)	+ 941
LRT 2	3.63	0.02	4.16	-	3	550	2,650	2,900,000	(66,327,360)	(16,730)
LRT 3	4.1	-	4.4	-	4	250	1,250	6,400,000	(105,707,840)	(22,372)
LRT 4	1.07	-	11.58	-	11	240	1341	2,485,093	(46,585,483)	(9,438)
LRT 5	0	-	8	-	10	2,553	125	619,704	(1,569,477)	+2,652
LRT 6	0.48	-	1.12	-	3	-	257	179,744	(6,729,300)	(1,770)
LRT 7	3	0.5	11	-	16	1,847	640	3,235,204	(36,894,915)	(844)
LRT 8	1.02	-	3.68	-	7	180	-	1,021,545	(12,188,214)	(898)
LRT 9	4.04	0.04	6.85	-	9	650	520	2,770,880	(45,122,744)	(7,918)
LRT 10	0.3	-	2	-	3	75	2,025	662,712	(27,966,900)	(8,725)
LRT 11	0.7	0.6	9.7	-	21	-	-	2,821,918	(65,227,432)	(13,549)
LRT 12	0	1.9	0	3	-	-	-	2,003,400	(138,743,400)	(40,598)

Source: FTA 2024, Appendix B.
LRT = light rail transit; $MTCO_{2}e$ = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled

4 Affected Environment

4.1 Regional Conditions

4.1.1 Air Quality Control Region

The Austin MSA in south central Texas represents the air basin or air quality control region for the Project. According to the U.S. Census Bureau (2023), approximately 2.3 million residents live in the Austin MSA. The area is home to numerous industries, commercial areas, aviation activity, and a robust transportation system, all of which contribute to changes in local air quality. Regional pollutants include ozone, nitrogen oxides, volatile organic compounds, carbon monoxide, particulate matter, and sulfur dioxide. Air quality pollutant concentrations on any given day represent a combination of emissions from all these sources.

4.1.2 Local Air Quality and Meteorological Conditions

Air quality is affected by the rate and locations of pollutant emissions and meteorological conditions that influence the movement and dispersal of pollutants in the atmosphere. These conditions include wind speed and direction, air temperature gradients, and local topography. Austin is located in generally flat to rolling topography (400 feet to 1,000 feet elevation) that does not hinder or trap air movement like large hills and mountains would. The Austin area climate is humid subtropical with hot summers and generally mild winters. Average temperatures in Austin vary from 40 degrees Fahrenheit (°F) in January to 97°F in August (U.S. Climate Data 2023), with annual average precipitation of approximately 36 inches (National Oceanic and Atmospheric Administration [NOAA] 2023). Prevailing winds for the Austin area are generally out of the south. Austin area weather conditions include extended hot summers and occasional stagnant, foggy conditions during winter with temperature inversions, all of which are conducive to either forming or trapping air pollutants within the lower atmosphere.

With respect to ozone, winter inversions and fog conditions are not as frequent during the year or do not affect ozone exceedances as much as hot summer conditions do. According to TCEQ, highest concentrations of ozone form on sunny days with low wind speeds, as high-pressure systems dominate the regional weather and tend to produce clear skies that increase photochemical reaction with stagnant winds (TCEQ 2023a). The ozone forecast season in central Texas is from April 1 to October 31, and TCEQ forecasts ozone action days during this period for several regions, including the Austin metropolitan area (TCEQ 2023a).

4.1.3 Sources of Air Emissions

Air emissions in the Central Texas region are from stationary point sources such as fossil fuel fired power plants, smelters, industrial boilers, petroleum refineries, boilers, and manufacturing facilities and from non-point sources such as area, on-road mobile, non-road mobile, and biogenic sources.

Area sources are small-scale industrial, commercial, and residential sources that generate emissions (TCEQ 2024). Area sources include the following:

- Stationary source fuel combustion;
- Solvent use (e.g., small surface coating operations);
- Product storage and transport distribution (e.g., gasoline);
- Light industrial/commercial sources;
- Agriculture (e.g., feedlots, crop burning, tilling);
- Waste management (e.g., landfills); and
- Miscellaneous area sources (e.g., forest fires, wind erosion, unpaved roads).

On-road mobile sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways (TCEQ 2024). On-road mobile sources include the following:

- Light-duty gasoline vehicles;
- Light-duty gasoline trucks up to 6,000 pounds gross vehicle weight;
- Light-duty gasoline trucks from 6,001 to 8,500 pounds gross vehicle weight;
- Heavy-duty gasoline vehicles greater than 8,500 pounds gross vehicle weight;
- Light-duty diesel vehicles;
- Light-duty diesel-powered trucks;
- Heavy-duty diesel vehicles greater than 8,500 pounds gross vehicle weight; and
- Motorcycles.

Non-road mobile sources consist of vehicles that do not typically operate on roads or highways; these are often referred to as off-road or off-highway vehicles (TCEQ 2024). Non-road mobile sources include the following:

- Agricultural equipment;
- Construction and mining equipment;
- Lawn and garden equipment;
- Aircraft and airport equipment;
- Locomotives;
- Commercial marine vessels; and
- Drilling rigs.

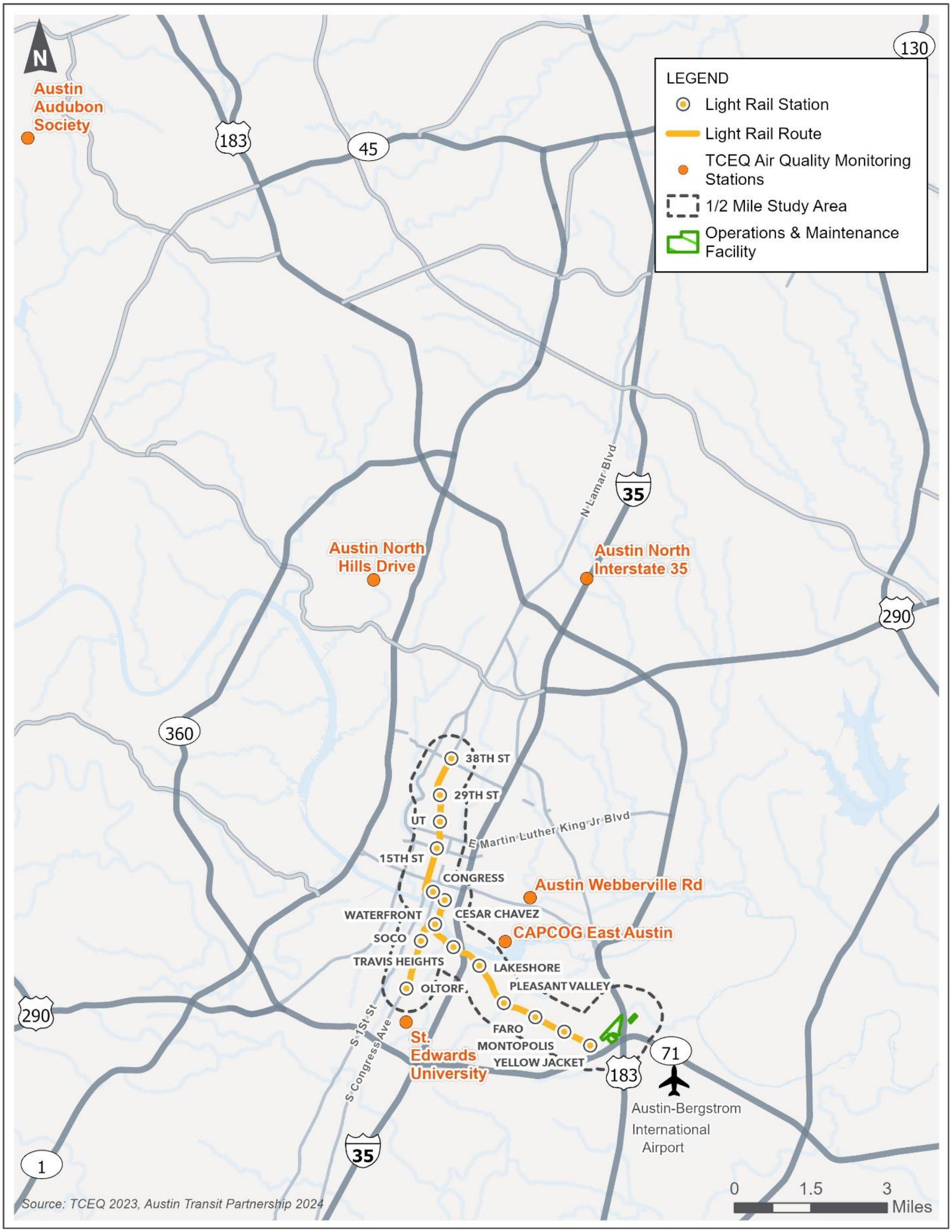
Biogenic sources include volatile organic compound emissions from crops, lawn grass, and trees as well as nitrogen oxides from soils. Plants are sources of volatile organic compounds such as isoprene, monoterpene, and alpha-pinene (TCEQ 2024).

4.2 Air Quality Monitoring and Attainment Status

EPA has designated areas of the country as being in attainment when meeting NAAQS or nonattainment when not meeting the NAAQS on a pollutant-by-pollutant basis. Previously designated nonattainment areas that have demonstrated attainment are known as maintenance areas. The nonattainment areas are designated based on the degree of violation of the NAAQS. When an area is designated as nonattainment by EPA, the state is required to develop and implement a State Implementation Plan, which delineates the plan to achieve air quality that meets the NAAQS within the deadlines established by the Clean Air Act. The State Implementation Plan is followed by a plan for maintaining attainment status once the area is in attainment.

For Texas, EPA has delegated authority for monitoring and enforcing air quality regulations to TCEQ. The TCEQ Office of Air is responsible for implementing and enforcing air quality regulations in Austin. TCEQ also operates a statewide network of air quality monitors that continuously measure air quality; air quality monitoring data are available through EPA's AirData website (EPA 2023c). There are six active continuous ambient monitoring stations near and around the Study Area. These are the Austin North Hills Drive (*AQS Site 48-453-0014*), Austin Audubon (*AQS Site 48-453-0020*), Austin North Interstate (*AQS Site 48-453-1068*), Austin Webberville Road (*AQS Site 48-453-0021*), Capital Area Council of Governments (CAPCOG) East Austin (*AQS Site 48-453-1619*), and Saint Edwards University (*AQS Site 48-453-1605*) sites (EPA 2023c). **Figure 1** shows the locations of the air monitoring sites in relation to the Study Area. **Table 3** lists 2023 air monitoring data for the air quality monitoring stations near the Study Area.

Figure 1: Air Quality Monitoring Stations near the Study Area



Source: TCEQ 2023b.

Table 3: 2023 EPA Air Quality Monitoring Values Report for Austin MSA

Pollutant and NAAQS	Monitoring Station Name and Site ID	Address	1-hour	8-hour
Carbon monoxide (CO): 35 ppm (1-hour), 9 ppm (8-hour)	Austin North Interstate (484531068)	8912 North I 35 Service Road, Austin, TX	2.7 ppm	1.6 ppm
Nitrogen dioxide (NO_2): 100 ppb (1-hour)	**Monitoring Station Name and Site ID**	**Address**	**98th Percentile (1-hour)**	**Annual (1-hour)**
	Austin North Hills Drive (484530014)	3824 North Hills Drive Austin, TX	30 ppb	3.71 ppb
	Austin North Interstate (484531068)	8912 N North I 35 Service Road, Austin, TX	44 ppb	13.47 ppb
Ozone (O_3): 0.12 ppm (1-hour), 0.070 ppm (8-hour)	**Monitoring Station Name and Site ID**	**Address**	**1-hour**	**8-hour**
	Austin North Hills Drive (484530014)	3824 North Hills Drive, Austin, TX	0.084 ppm	0.074 ppm
	Austin Audubon (484530020)	12200 Lime Creek Road, Austin, TX	0.082 ppm	0.070 ppm
Particulate matter smaller than 10 microns in diameter (PM_{10}): 150 ug/m^3 (24-hour)	**Monitoring Station Name and Site ID**	**Address**	**24-hour (First Max)**	**24-hour (Second Max)**
	Austin Audubon (484530020)	12200 Lime Creek Road, Austin, TX	49 ug/m^3	48 ug/m^3
	Austin Webberville Road (484530021)	2600b Webberville Road, Austin, TX	56 ug/m^3	53 ug/m^3
	Austin Webberville Road (484530021)	2600b Webberville Road, Austin, TX	41 ug/m^3	40 ug/m^3

Pollutant and NAAQS	Monitoring Station Name and Site ID	Address	1-hour	8-hour
Particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$): 35 ug/m^3 (24-hour), 9.0 ug/m^3 (annual)	**Monitoring Station Name and Site ID**	**Address**	**24 hour 98th Percentile**	**Annual Mean**
	Austin North Hills Drive (484530014)	3824 North Hills Drive, Austin, TX	25 ug/m^3	9.9 ug/m^3
	Austin Webberville Road (484530021)	2600b Webberville Road, Austin, TX	23 ug/m^3	8.4 ug/m^3
	Austin Webberville Road (484530021)	2600b Webberville Road, Austin, TX	24 ug/m^3	9.4 ug/m^3
	Austin Webberville Road (484530021)	2600b Webberville Road, Austin, TX	18 ug/m^3	9.3 ug/m^3
Sulfur dioxide (SO_2) 75 ppb (1-hour), 140 ppb (24-hour)	**Monitoring Station Name and Site ID**	**Address**	**24-hour (Second Max)**	**Annual Mean**
	Austin North Hills Drive (484530014)	3824 North Hills Drive, Austin, TX	0.7 ppb	0.12 ppb

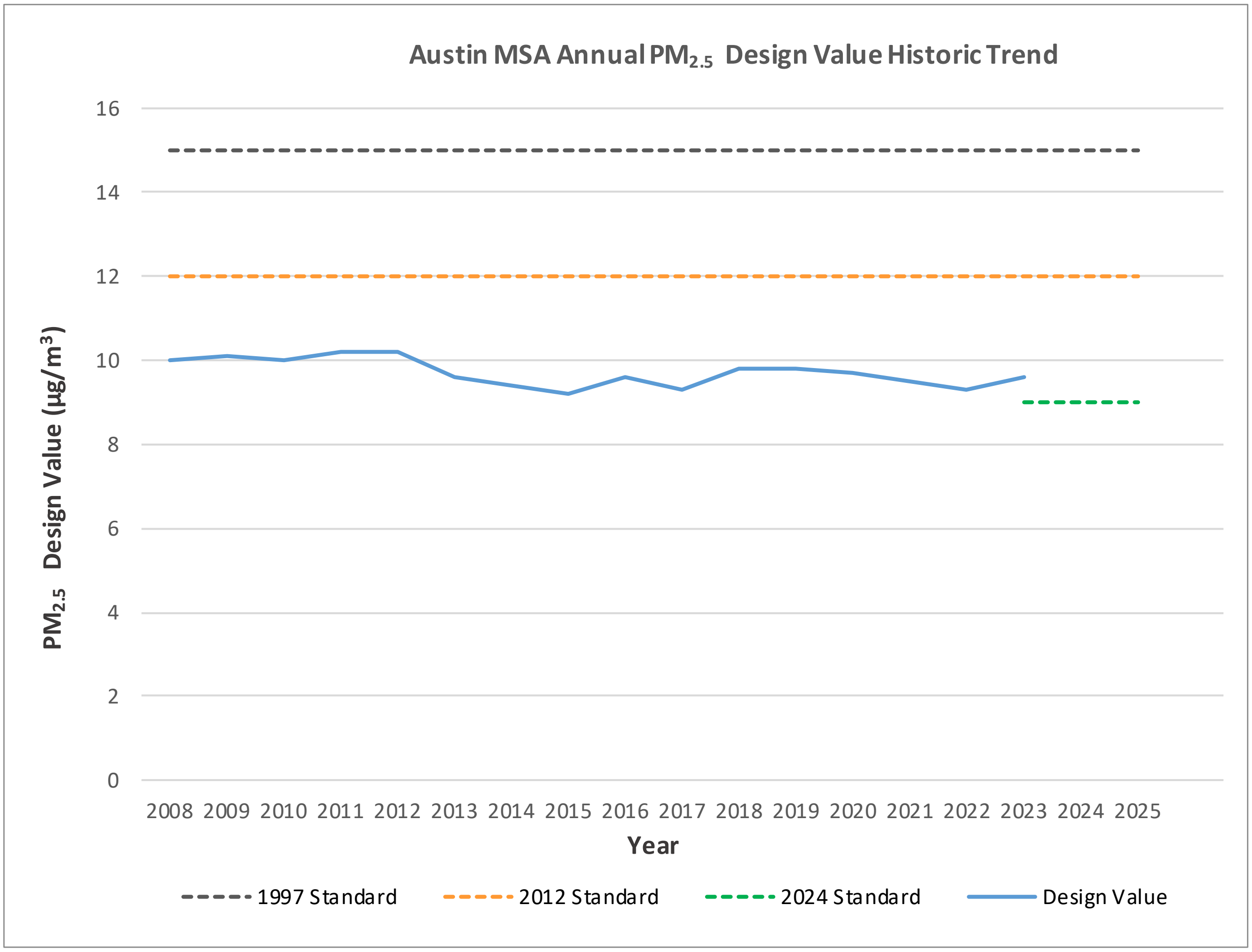
Source: EPA 2024b.

Note: Monitoring values for CAPCOG East and St. Edwards monitoring sites were not included in the EPA Monitor Values report. However, based on data published by TCEQ and CAPCOG stating that the Austin-MSA is designated as attainment for all NAAQS, both the CAPCOG East and St. Edwards monitors show air quality readings that meets the NAAQS. Lead (Pb) is not a pollutant of concern for the Austin MSA, which includes Travis County. The Austin MSA continues to be designated as in attainment with NAAQS; however, based on the 2023 air quality monitoring data, the Austin MSA values exceeded federal standards for ozone and $PM_{2.5}$. TCEQ continues to monitor regional air quality and will work with EPA to determine changes required to reduce ozone and $PM_{2.5}$ pollutant levels to meet the standards.

ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter

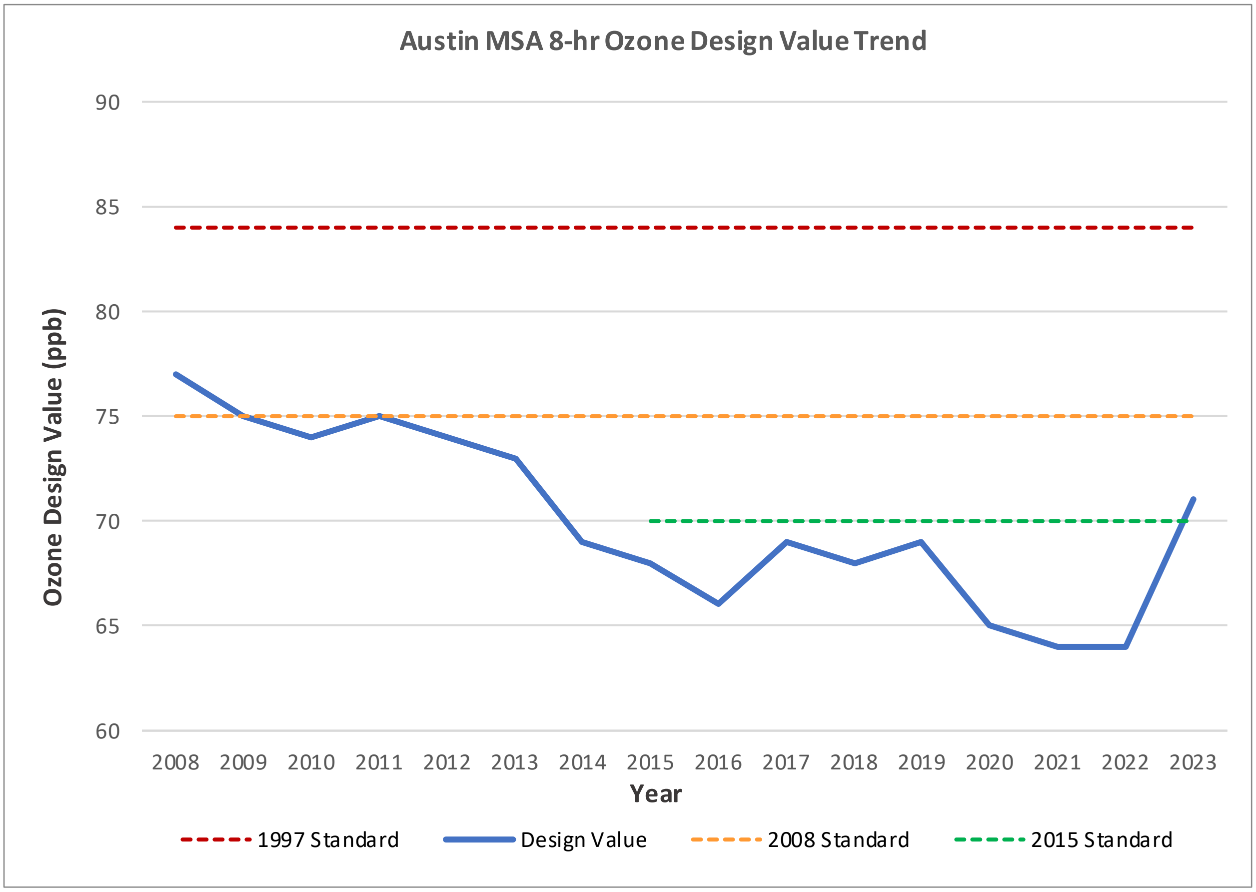
The Project is located in Travis County, within the Austin MSA, which is in attainment or unclassifiable for all NAAQS (TCEQ 2024). Historically, the Austin MSA has maintained compliance with NAAQS. However, as it relates to the new 2024 $PM_{2.5}$ annual standard, which is 9.0 ug/m^3, the Austin MSA 2023 air quality monitoring values (see **Table 3** above) were higher than the new annual standard and trending toward noncompliance with the new NAAQS, as shown in **Figure 2**. Although the 2023 $PM_{2.5}$ monitoring values exceed the 2024 $PM_{2.5}$ annual standard, the Austin MSA is still designated as an attainment or unclassifiable area (TCEQ 2024). CAPCOG is working with members of the Austin MSA to evaluate and implement fine particulate matter emission reduction measures and ensure compliance with the 2024 $PM_{2.5}$ annual NAAQS. The Austin MSA complies with the 24-hour $PM_{2.5}$ standard of 35 ug/m^3.

Figure 2: Change in Austin MSA Annual $PM_{2.5}$ Design Value Compared to NAAQS



As shown in **Figure 3**, from 2012 to 2022, the Austin MSA air pollution levels remained in compliance with the ozone NAAQS (CAPCOG 2024). This trend may have been due to the aggressive and ambitious emissions reduction policies in the Austin area, such as Austin Energy's commitment to producing renewable energy, fleet electrification, and vehicle emission standards. The ozone design value consistently decreased and was below the 2015 8-hour ozone standard; however, in 2023, the ozone design value exceeded the 2015 8-hour ozone standard, resulting in noncompliance with the ozone NAAQS. Although the 2023 design value exceeded the 8-hour ozone NAAQS, the Austin MSA is still designated as an attainment or unclassifiable area. CAPCOG is working with members of the Austin MSA to evaluate and implement emission reduction measures and achieve compliance with the 2015 8-hour ozone NAAQS. As shown in **Table 3** above, the design values for all other criteria air pollutants are well below the respective NAAQS for each pollutant.

Figure 3: Change in Austin MSA Ozone Design Value Compared to NAAQS



Source: CAPCOG 2024.

As previously noted, on February 7, 2024, EPA announced a final rule to strengthen the NAAQS for fine particulate matter, $PM_{2.5}$ (EPA 2024a). EPA lowered the primary annual $PM_{2.5}$ standard from 12 μg/m³ to 9.0 μg/m³. Travis County's recent air quality monitoring data recorded an average annual design value of 9.3 μg/m³ in 2022 and 9.6 μg/m³ in 2023, which exceeds the 2024 $PM_{2.5}$ standard of 9.0 μg/m³. In accordance with the Clean Air Act, EPA will make initial attainment/nonattainment designations based on the new standard (likely within the next 2 years) working closely with states throughout the designations process. If EPA designates the Austin MSA as nonattainment for this standard, TCEQ would need to develop and submit an attainment plan no later than 18 months after EPA finalizes designations (EPA 2024a).

4.3 Greenhouse Gases and Climate Change

Global climate change refers to changes in average climatic conditions on Earth, including changes in temperature, wind patterns, precipitation, storms, glacial retreat, and sea-level rise. Global climate change is a regional and, ultimately, a worldwide concern. Historical records indicate that global climate changes have occurred in the past due to natural phenomena. However, since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil, and gas. Burning fossil fuels generates

GHG emissions that trap the sun's heat and raise temperatures (United Nations, n.d.). Because GHG effects are experienced on a global scale, it is impossible to discuss direct effects of a single development project with respect to future specific climate change.

GHGs[3] include carbon dioxide, methane, water vapor, nitrous oxide, and fluorinated gases such as chlorofluorocarbons. Carbon dioxide is a minor but important component of the atmosphere and the primary GHG pollutant emitted by the combustion of fossil fuels. Water vapor is the most abundant GHG and makes up approximately two-thirds of the natural GHG effect. Although carbon dioxide is released by natural processes, the burning of fossil fuels by humans produces substantial amounts of these gases. Changes in global carbon dioxide emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population and economic growth, energy price fluctuations, technological changes, and seasonal temperatures. This increase in carbon dioxide and other GHG emissions is tied directly to rapid climate change and the ability of natural systems to moderate this change. Furthermore, warmer global temperatures associated with climate change may cause changes in precipitation, sea levels, and storm frequency and intensity, and could contribute to increased drought and forest fires.

The largest contributor to GHG emissions in the United States is transportation[4] (28 percent of 2021 GHG emissions), followed closely by electricity production (25 percent of 2021 GHG emissions). The industrial (23 percent of 2021 GHG emissions), residential, commercial, and agriculture sectors also contribute to GHG emissions. In 2020, United States GHG emissions totaled 5,981 million metric tons (13.2 trillion pounds) of carbon dioxide equivalent. This total represents a 7 percent decrease since 1990 and a 20 percent decrease since 2005 (EPA 2023b); however, annual GHG emissions rise and fall due to changes in the economy, the price of fuel, and other factors. Between 1990 and 2020, carbon dioxide emissions decreased by 8 percent; methane emissions decreased by 17 percent; and nitrous oxide emissions, predominantly from agricultural soil management practices such as the use of nitrogen as a fertilizer, decreased by 5 percent (EPA 2023b). Emissions of fluorinated gases (hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride), released as a result of commercial, industrial, and household uses, increased by approximately 90 percent, from 99.6 million metric tons of carbon dioxide equivalent in 1990 to 189 million metric tons of carbon dioxide equivalent in 2020 (EPA 2023d).

Given their characteristic rapid dispersion into the global atmosphere, GHGs are different from other air pollutants evaluated in federal environmental reviews because the effects are not localized. The resource study area for carbon dioxide and other GHG emissions is the entire planet. From a quantitative perspective and in terms of absolute numbers and types, global climate change is the cumulative result of many varied natural and anthropogenic emissions sources. Each source makes a relatively small addition to global atmospheric GHG

---

3 Some GHGs, such as carbon dioxide and methane, are emitted to the atmosphere through both natural processes and human activities. Other GHGs, such as fluorinated gases, are solely human-made.

4 In 2021, the combustion of transportation fuels was the largest source of carbon dioxide, contributing 28 percent of the United States GHG emissions; electricity production contributed 25 percent of the United States GHG emissions.

concentrations, and it is difficult to isolate and understand the GHG emissions effects for a particular transportation project. Presently, there is no scientific methodology for attributing specific climatological changes to a particular transportation project's emissions.

Currently, no national standards or thresholds for ambient GHG emissions have been established. However, there is a considerable body of scientific literature addressing the sources of GHG emissions and their effects on climate, including reports from the Intergovernmental Panel on Climate Change, the National Academy of Sciences, EPA, and other federal agencies. According to NOAA (2023), the global average temperature has increased 1.4°F since the early 20th century. In addition, 2022 is the world's sixth warmest year on record (NOAA 2023). Furthermore, the 10 warmest years on record have all occurred since 2010 (NOAA 2023). Climate-related changes resulting from GHG emissions are already observed in the United States and will increase in the future. These changes include rising temperature and sea levels, increases in both extreme downpours and droughts, and stronger hurricanes. Reducing GHG emissions will lower the severity of these effects over the long term (NOAA 2021). Texas-specific regional data and analysis available from the Office of the Texas State Climatologist (2021) states that the average annual Texas surface temperature in 2036 is expected to be 3.0°F warmer than the 1950–1999 average and 1.8°F warmer than the 1991–2020 average. The number of 100-degree days is expected to nearly double by 2036 compared to 2001–2020, with higher frequency of 100-degree days in urban areas. Extreme monthly summertime temperatures may increase by about 1°F compared to the 1950–1999 average. Extreme monthly wintertime temperatures are expected to continue to increase at an even faster rate, and the coolest days of the summer are expected to continue becoming warmer. Extreme precipitation is expected to increase in intensity on average statewide by 6 percent to 10 percent relative to 1950–1999 and 2 percent to 3 percent relative to 2001–2020 (Office of the Texas State Climatologist 2021).

As previously stated, GHG emissions from transportation sources are directly related to energy consumption and primarily result from the combustion of fossil fuels in vehicles. More than half of the GHG emissions from transportation sources come from passenger cars, medium- and heavy-duty trucks, and light-duty trucks, including sport utility vehicles, pickup trucks, and minivans. The remaining GHG emissions come from other modes of transportation including freight trucks, commercial aircraft, ships, boats, and trains, as well as pipelines and lubricants (EPA 2023e). To reduce GHG emissions from transportation sources, effective planning must incorporate and prioritize modes of transport that increase mobility energy productivity and use less energy per person per mile traveled or use energy from low-carbon fuels. Currently, transit is expected to reduce the use of automobiles and single-occupant vehicles that contribute a high percentage of GHG emissions.

5 Environmental Consequences

5.1 No Build Alternative

The No Build Alternative includes the existing transportation network and the improvements included in the CAMPO *2045 Regional Transportation Plan* (CAMPO 2024a). Under the No Build Alternative, the miles traveled would increase because population and employment opportunities in the Austin MSA are projected to continue the historic growth trends. From 2010 to 2020, Austin's population increased from approximately 790,390 in 2010 to 961,900 in 2020, a growth of approximately 22 percent over the 10-year period (U.S. Census Bureau 2023). Travis County population increased by 26 percent, from 1.02 million in 2010 to 1.29 million in 2020 (U.S. Census Bureau 2023). By 2045, Austin's population is projected to reach 1.3 million, an increase of approximately 39 percent when compared to 2020 population data.

The Austin MSA has been the fastest-growing area in the country for the 12th consecutive year (City of Austin 2023). As population and employment increase, the daily VMT measured by the Texas Department of Transportation's (TxDOT) Austin District have shown increases. This rapid population growth means more vehicles on Texas roads and consequently, increased congestion (TxDOT 2024). As population increases, VMT are projected to increase as well; the Federal Highway Administration (FHWA) forecasts that VMT will increase at an average annual rate of 0.6 percent between 2019 and 2049 (FHWA 2023). Therefore, under the No Build Alternative, automobile VMT would increase in the region because of the expected increase in population and employment in the Austin area. **Table 4** shows the existing (2022) and No Build daily VMT in the Austin region, which includes Travis, Burnet, Williamson, Hays, Bastrop, Caldwell Counties. Data in **Table 4** is derived from TxDOT's *Roadway Inventory Annual Reports* (2022) and CAMPO's travel demand model 2045 forecast (2024b). According to TxDOT, the Austin region daily VMT would be expected to increase from approximately 62 million in 2022 to approximately 141 million under the 2045 No Build Alternative. **Table 5** shows the estimated pollutant emissions under the No Build Alternative; this estimate does not account for infrastructure improvements, climate action programs, and efficiency improvements that may be implemented to reduce emissions in 2045.

Table 4: Comparison of Existing (2022) and 2045 No Build Daily VMT in the Austin Region

Parameter	Existing Conditions (Based on TxDOT 2022 and CAMPO 2024b)	2045 No Build Alternative
Total Daily VMT for Austin Region	61,958,037.28	141,074,241.89

Sources: TxDOT 2022; CAMPO 2024b.

Note: Total daily VMT includes on-system and off-system car and truck vehicle miles traveled. Travis County daily VMT would be expected to increase from 31.3 million in 2022 to approximately 71.3 million under the 2045 No Build Alternative.

Table 5: 2045 No Build Estimated Pollutant Emissions

Pollutant	Emission Factor (grams per mile)	2045 No Build Daily Emissions in Pounds	2045 No Build Annual Emissions in Pounds
Volatile organic compounds[a]	0.219	68,112 [b]	22,136,499 [c]
Carbon monoxide (CO)	2.544	791,222	257,147,280
Nitrogen oxides (NO_x)	0.241	74,954	24,360,257
Total particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$)[d]	0.010	3,110	1,010,799

Sources: Bureau of Transportation Statistics 2023 (pollutant emission factors); FHWA's Infrastructure Carbon Estimator v2.1.3 (ICE); Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, 2021 release. See Attachment A, Air Quality Emissions Calculations.

Note: Calculations shown used the 2030 Average Emissions Per Vehicle: Gasoline and Diesel Fleet emission factors published by Bureau of Transportation Statistics 2023.

[a] Volatile organic compound emission rates are equal to total hydrocarbons in Table 4-43 (Bureau of Transportation Statistics 2023); Total hydrocarbons include exhaust and evaporative emissions.

[b] Calculation for daily pollutant emissions in pounds = Emission Factor in grams per mile x daily VMT x 0.002205 pounds/ per gram. For example, daily emissions of volatile organic compounds in pounds = 0.219 grams per mile x 141million Daily VMT x 0.002205 pounds per gram = 68,112 pounds per day.

[c] Calculation for annual pollutant emissions in pounds = Emission Factor in grams per mile x Annual VMT x 0.002205 pounds/ per gram.

[d] Total $PM_{2.5}$ includes Exhaust $PM_{2.5}$, Brake Wear $PM_{2.5}$, and Tire Wear $PM_{2.5}$.

Historically, the Austin MSA has maintained compliance with all NAAQS. However, in May 2024, EPA lowered the $PM_{2.5}$ annual standard from 12.0 ug/m^3 to 9.0 ug/m^3. As a result, the Austin MSA air quality monitoring values recorded in 2024 were higher than this new $PM_{2.5}$ annual standard, as shown in **Figure 2** above. Although the 2023 $PM_{2.5}$ monitoring values exceed the 2024 $PM_{2.5}$ annual standard, the Austin MSA is still designated as an attainment or unclassifiable area (TCEQ 2024). CAPCOG is working with members of the Austin MSA to evaluate and implement fine particulate matter emission reduction measures and ensure compliance with the NAAQS. The Austin MSA complies with the 24-hour $PM_{2.5}$ standard, 35 ug/m^3.

Air pollution levels within the Austin MSA have remained in compliance with the NAAQS, and the ozone design value was below the 2015 8-hour ozone standard (see **Figure 2** above). However, in 2023, the ozone design value exceeded the 2015 8-hour ozone standard, resulting in noncompliance with the ozone NAAQS. While the 2023 design value exceeded the 8-hour ozone NAAQS, the Austin MSA is still designated as an attainment or unclassifiable area. CAPCOG is working with members of the Austin MSA to evaluate and implement emission reduction measures and achieve compliance with the 2015 8-hour ozone NAAQS. As shown in **Table 3** above, the design values for all other criteria air pollutants are well below the respective NAAQS for each pollutant.

Although there is limited available data, the recent exceedances in the 2015 8-hour ozone and 2024 $PM_{2.5}$ annual NAAQS may represent a trend toward future exceedances or noncompliance with air quality regulations, especially when considering the projected regional growth in population, employment, and VMT. CAMPO is continuing to evaluate land use, multimodal transportation approaches, enhancements to the transit and bicycle/pedestrian network, Transportation Demand Management strategies, and other programs and activities to ensure that the region's air quality remains in compliance with NAAQS and maintain its attainment status.[5]

When considering GHGs and climate change, the 2045 No Build Alternative daily VMT is approximately 141 million, as previously noted. **Table 6** lists the EPA emission factor used in the analysis, and **Table 7** shows estimated GHG emissions in metric tons per year, for both the existing conditions and the 2045 No Build Alternative.

Table 6: Carbon Dioxide Equivalent Emission Factor used in Analysis

Pollutant	EPA Emission Factor (grams per mile)	EPA Emission Factor (metric ton per mile)
GHG (CO_2e)	391	0.000391

Table 7: 2045 Existing Conditions and No Build Estimated GHG Emissions

	Existing Conditions	2045 No Build Alternative
Daily VMT (miles)	61,958,037.3	141,074,241.9
2045 No Build GHG CO_2e Emissions in Metric Tons Per Day	24,225.6	55,160.0
2045 No Build GHG CO_2e Emissions in Metric Tons Per Year	7,873,317.6	17,927,009.3

Sources: TxDOT 2022; CAMPO 2024b. See Attachment A, Air Quality Emissions Calculations
Notes: VMT Annualization factor = 325
Annual VMT = Daily VMT x Annualization factor
Calculation for pollutant emissions in Metric Tons = Emission Factor in metric ton per mile x VMT

[5] Because the Study Area is designated as attainment for the 8-hour ozone standard, it is eligible to participate in EPA's 8-Hour Ozone Flex Program. The program is implemented through a voluntary intergovernmental agreement (Memorandum of Agreement) among EPA, TCEQ, and the local communities. The Austin-Round Rock 8-Hour Ozone Flex Memorandum of Agreement commits the Austin-Round Rock area to continuing the implementation of the Early Action Compact State Implementation Plan and voluntary emission reduction measures. There are no further State Implementation Plan requirements for the existing standard as long as the area continues to be in attainment for the standard (EPA 2008).

Climate-related changes resulting from air emissions are already observed and will increase in the future. Recent projections for Austin indicate a future with hotter summers, more frequent heat waves, and fewer cold spells (UT-City Climate CoLab 2024). According to the Texas State Climatologist, the projected average annual Texas surface temperature in 2036 is expected to be 3.0°F warmer than the 1950 to 1999 average and 1.8°F warmer than the 1991 to 2020 average. By 2036, the number of 100-degree days is expected to nearly double when compared to 2001 to 2020, with a higher frequency of 100 degree days in urban areas. Extreme monthly summer temperatures may increase by about 1°F compared to the 1950 to 1999 average.

The frequency of extreme weather events, more climate variability, and extreme monthly winter temperatures are expected to increase by 6 to 10 percent relative to 1950 to 1999 and 2 to 3 percent relative to 2001 to 2020 (Office of the Texas State Climatologist 2021).

By the end of the century, summer maximum temperatures are projected to increase, with temperatures above 110°F becoming more frequent (City of Austin 2024). Heat waves, defined as 3 or more consecutive days with excessively hot weather, are expected to also increase by the end of the century (UT-City Climate CoLab 2024). Fewer frost days and freeze spells are expected, with cold spells lasting about as long as usual. The number of frost days, when the minimum temperature drops below 32°F, is expected to decrease substantially by the end of the century (UT-City Climate CoLab 2024). Extreme rainfall events, where more than 2 inches of rain falls in 1 day, are expected to occur slightly more often (UT-City Climate CoLab 2024). However, the total annual rainfall, which is the amount of rain over any 5 consecutive wet days, and the number of rainy days each year are projected to stay relatively the same (City of Austin 2024).

5.2 Build Alternative and Design Options

There would be nominal emissions reduction differences between the Build Alternative and the Design Options because the VMT reduction would be similar in all cases. As a result, this report presents the environmental consequences results for only the Build Alternative; the conclusions apply to the Build Alternative as well as the Design Options.

5.2.1 Operational (Long-Term) Effects

Implementation of the Project would result in new transit riders as some automobile drivers switch to light rail. This would result in a decrease of VMT in Travis County and surrounding areas compared to the No Build Alternative. **Table 8** shows the 2045 Build Alternative daily VMT reduction as compared to the 2045 No Build Alternative. The Project would result in a decrease of approximately 61,965 VMT per day (approximately 20.14 million VMT per year) in the Austin area. As such, operation of the Build Alternative would have lower carbon monoxide, volatile organic compounds, and GHG emissions and would generally result in a long-term net benefit to air quality by reducing emissions of criteria pollutants, air toxics, and GHGs.

Table 8: Calculation of Daily VMT Reduction for the Project

Category	2045 No Build Alternative	2045 Build Alternative
System Linked trips	109,200	121,700
System Unlinked trips	151,000	168,100
Project total trips	N/A	28,968
Change in passenger miles traveled	N/A	68,200
Average vehicle occupancy	N/A	1.1
Total Daily VMT	141,074,242	141,012,277
Total Annual VMT	45,849,128,614	45,828,989,988
Change in Daily VMT	**N/A**	**(61,965)**
Change in Annual VMT [a]	**N/A**	**(20,138,625)**

Sources: STOPS model; TxDOT 2022; CAMPO 2024b.
Note: Passenger miles traveled data were from the STOPS model; average vehicle occupancy was from the CAMPO 2045 Regional Travel Demand Model.
[a] Annualization VMT factor = 325 (from STOPS model).

5.2.1.1 Criteria Pollutants and Mobile Source Air Toxics

The Project would include the operation of an electric light rail system powered by overhead catenary electrical wires and would not result in direct air pollutant emissions in the Study Area. However, train and station power consumption of electricity from the electric grid would potentially contribute to GHG emissions at power plants located elsewhere in Texas. Austin Energy would supply the electricity to power the Project. In 2023, 70 percent of Austin Energy's portfolio was carbon-free energy. Austin Energy plans to phase out its single remaining coal-powered plant and move to 100 percent carbon-free generation by 2035 (Austin Energy 2023).

Because there would be no direct emissions of air pollutants from the light rail vehicles during operations, the VMT reductions (-61,965 daily VMT) shown in **Table 8** are a direct representation of net pollutant reductions within the Austin MSA. **Table 9** shows the daily and annual pollutant emissions reductions under the 2045 Build Alternative. As shown, the operation of the Project would result in travel mode shifts that would remove vehicles responsible for annual emissions amounting to approximately 9,723.2 pounds of volatile organic compounds, 112,948.6 pounds of carbon monoxide, 10,699.9 pounds of nitrogen oxides, and 443.98 pounds of $PM_{2.5}$. Removal of these motor vehicle emissions produced on Austin area roadways annually would reduce emissions and result in a beneficial air quality effect on the Austin area.

Table 9: Calculation of Pollutant Reductions for the Project

Pollutant	Emission Factor (grams per mile)	2045 Daily Reductions (pounds)	2045 Annual Reductions (pounds)
Volatile organic compounds[a]	0.219	(29.92)[b]	(9,723.17)[c]
Carbon monoxide (CO)	2.544	(347.53)[d]	(112,948.55)
Nitrogen oxides (NO_x)	0.241	(32.92)[e]	(10,699.92)
Total particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$)[f]	0.010	(1.37)[g]	(443.98)

Sources: Pollutant emission factors from Bureau of Transportation Statistics 2023, FHWA's Infrastructure Carbon Estimator v2.1.3 (ICE), and the Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, 2021 release.
Note: Calculations shown used the 2030 Average Emissions Per Vehicle: Gasoline and Diesel Fleet emission factors published by Bureau of Transportation Statistics 2023.

[a] Volatile organic compound emission rates are equal to total hydrocarbons in Table 4-43 (Bureau of Transportation Statistics 2023); Total hydrocarbons includes exhaust and evaporative emissions.

[b] Calculation for daily pollutant reductions in pounds = Emission Factor in grams per mile x 61,965 daily VMT x 0.002205 pounds/ per gram. For example, daily reduction of volatile organic compounds in pounds = 0.219 grams per mile x 61,965 daily VMT x 0.002205 pounds per gram = 29.92 pounds per day

[c] Calculation for annual pollutant reduction in pounds = Emission Factor in grams per mile x 20,138,625 annual VMT x 0.002205 pounds/ per gram. For example, annual volatile organic compounds = 0.219 grams per mile x 20,138,625 daily VMT x 0.002205 pounds/ per gram = 9,723.17 pounds per year

[d] Calculation for carbon monoxide = 2.544 grams per mile x 61,965daily VMT x 0.002205 pounds per gram = 347.53 pounds per day

[e] Calculation for nitrogen oxides = 0.241 grams per mile x 61,965 daily VMT x 0.002205 pounds per gram = 32.92 pounds per day

[f] Total PM2.5 includes Exhaust PM2.5 = 0.005 grams per mile, 0. 683 pounds per day, 221.99 pounds per year; Brake Wear PM2.5 = 0.003 grams per mile, 0.410 pounds per day, 133.19 pounds per year; and Tire Wear PM2.5 = 0.002 grams per mile, 0. 273 pounds per day, 88.79 pounds per year

[g] Calculation for Total PM2.5 = 0.010 grams per mile x 61,965 daily VMT x 0.002205 pounds per gram = 1.37 pounds per day, 443.98 pounds per year.

5.2.1.2 Greenhouse Gas and Climate Change Operational Effects

Transit projects generate GHG emissions during their construction, operations, and maintenance phases and can displace emissions by reducing personal vehicle emissions due to the transit "ridership effect." **Table 10** compares the GHG emissions reductions associated with four different transit modes. According to the FTA *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment*,[6] light rail projects with a high ridership effect, regardless of

[6] FTA considers it practical to assess the effects of GHG emissions and climate change for transit projects at a programmatic level. This programmatic assessment presents the results from an analysis to estimate direct and indirect GHG emissions generated from the construction, operations, and maintenance phases of projects across selected transit modes.

length, alignment, and number of stations, result in a net reduction in GHG emissions. Light rail vehicles are typically driven electrically with power being drawn from overhead catenaries. The majority of GHG emissions generated by light rail projects are operations-related upstream emissions associated with the production and generation of the purchased electricity used to power the light rail vehicle. For this reason, the net volume of annual GHG emissions from light rail projects largely depends on the fuel source used for electricity generation (FTA 2024).

Table 10: Estimated Annual GHG Emissions Considering Ridership and Auto Occupancy

Mode	Typical Vehicle Capacity (Standing and Sitting Passengers)	Average Vehicle Load, 2019–2021 (passengers, rate)	Average Net Annual GHG Emissions Factoring Ridership and Auto Occupancy ($MTCO_2e$)	Average Net Annual GHG Emissions, Original Estimate ($MTCO_2e$)
Commuter Rail	183	23 (12.3%)	(5,200)	9,900
Heavy Rail	140	17 (12.1%)	(8,900)	10,200
Light Rail	155	15 (9.7%)	(11,000)	(9,900)
Bus Rapid Transit	74	6 (8.2%)	(450)	710

Source: FTA 2024, Table 4-1.
Note: National Transit Database 2021 Revenue Vehicle Inventory for estimated transit capacities; FHWA "Average Vehicle Occupancy Factors for Computing Travel Time Reliability Measures and Total Peak Hour Excessive Delay Metrics (April 2018)" for automobile occupancy.
$MTCO_2e$ = metric tons of carbon dioxide equivalent

GHG effects from the Project would be different between the No Build Alternative and the Build Alternative due to emissions from regional VMT and light rail energy consumption. Long-term operations that would contribute to GHG emissions for the Project would be power generation for the electricity used by the light rail trains, stations, and ancillary facilities. For vehicle and bus travel, GHG emissions would be generated by passengers traveling to and from the stations. However, these emissions associated with vehicle and bus travel to train stations would be offset by the emission reductions from the reduction in VMT by passengers using electric light rail trains when traveling within the Austin area. Furthermore, the light rail vehicles are electrically powered with no direct emissions. Electricity from the electric grid would potentially contribute to GHG emissions at power plants. Austin Energy would supply the electricity to power the Project. In 2023, 70 percent of Austin Energy's portfolio was carbon-free energy. Austin Energy plans to phase out its single remaining coal-powered plant and move to 100 percent carbon-free power generation by 2035 (Austin Energy 2023). Because the Project would be completed in 2045, operation of the light rail would use 100 percent carbon-free electricity from Austin Energy. As such, there would be minimal indirect GHG emissions associated with the electricity use of the light rail operations. The Project is expected to generate net reductions in GHG emissions after considering the reduction in GHG emissions associated with displaced vehicle emissions and overall light rail vehicle construction, operations, and maintenance.

The magnitude of GHG emissions reduced by this change in mode of travel would be expected to be much greater than that generated by passenger travel to and from stations and by operation of the trains, stations, and ancillary facilities. **Table 11** shows the 2045 Build Alternative annual GHG (carbon dioxide equivalent) pollutant emissions for the existing conditions, 2045 No Build Alternative, and the Project. Due to the long-term reduction in VMT, direct GHG emissions are projected to decrease under the Project when compared to the No Build Alternative. As shown in **Table 11**, the Project during operations would remove approximately 1,061 tons of carbon dioxide equivalent per year, resulting in a beneficial air quality effect on the Austin area. Additionally, ATP will support the City of Austin's Climate Equity [Action] Plan and the Capital Metropolitan Transportation Authority (CapMetro) Sustainability Vision Plan.

Table 11: Comparison of VMT and the Associated GHG Emissions

Parameter	Existing Conditions	2045 No Build Alternative	2045 Build Alternative	Difference Between Build and No Build Alternatives (Estimated GHG Emissions based on VMT reduction)
Daily VMT	61,958,037.3	141,074,241.9	141,012,276.9	(61,965.0)
GHG (CO_2e) Emissions in Metric Tons Per Year	7,873,317.6	17,927,009.3	17,919,135.1	(7,874.2)

Sources: STOPS model; TxDOT 2022; CAMPO 2024b.
Note: Calculations are based on the reduction in VMT/displaced emissions and do not consider upstream or downstream emissions. **Table 12** shows net emissions after considering upstream and downstream emissions.
EPA Emission factor used in calculations = 0.000391 grams of CO2e per mile

As shown in **Table 12**, due to the long-term reduction in VMT, GHG emissions are projected to decrease under the Build Alternative when compared to the No Build Alternative.

The reduction in regional VMT would result in beneficial changes in GHG emissions after considering upstream (indirect) and downstream (direct) emissions. Upstream GHG emissions are those that occur later in time or are farther removed in distance from the proposed transit project, including extracting, processing, refining, and transporting fuel used to power the Project (FTA 2024).

Table 12: Estimated Upstream, Downstream, and Net GHG Emissions for the 2045 Build Alternative

	Annual VMT Reduction in Miles	Annual Upstream GHG Emissions in $MTCO_2e$	Annual Downstream GHG Emissions in $MTCO_2e$	Net GHG Emissions in $MTCO_2e$
2045 Build Alternative	20,138,625	3,103	(4,164)	(1,061)

Source: FTA Transit Greenhouse Gas Emissions Estimator.
Note: Detailed emissions calculations are included in Attachment A, Greenhouse Gas Emissions Calculations.
GHG = greenhouse gases; $MTCO_2e$ = metric tons of carbon dioxide equivalent

Because there would be no long-term increases in GHG emissions, there would be no long-term GHG adverse effects; therefore, the Project would not further contribute to or exacerbate the effects[7] of climate change in the greater Austin area. ATP is developing strategies that address a changing climate in accordance with FTA guidance. The strategies would include design, asset management, maintenance, emergency response, and operational policies and guidance. CapMetro has existing procedures for emergency response, maintenance, asset management, and operation and maintenance of the transportation system, which consider several changing climate scenarios over time. The Project would incorporate green infrastructure to reduce stormwater runoff and flood potential, and shade trees to address the comfort of passengers waiting for the train if not prohibited by right-of-way constraints. Additional resiliency measures are being identified via sustainable design guidelines that are currently under development for the Project.

5.2.2 Construction-Related (Short-Term) Effects

Construction of the Project would involve activities that could affect air quality. These activities would include the construction of the guideway, stations, parking, catenary system, and paving of separated right-of-way. The level and duration of potential effects depend on the type of construction activity and the construction methods used, including best management practices to minimize effects. Construction effects for the Project would be temporary and limited to the immediate vicinity of the construction sites, contractor laydown area, and access routes. These potential effects include:

- direct emissions from construction equipment and vehicles;
- increased emissions from motor vehicles due to temporary decreased roadway capacity and detours on nearby roadways during construction; and

7 It is important to note that the light rail system's electrical consumption may indirectly add GHG emissions related to upstream energy production outside the Study Area.

- fugitive dust, particulate matter, and other pollutant emissions from the use of heavy construction machinery, pavement removal, earthmoving, site grading, and station construction.

ATP would incorporate best management practices into construction contract documents and would monitor contractor compliance with the construction specifications as well as state and local regulations, including the Texas Low Emission Diesel Fuel Program for all diesel-fueled on-road motor vehicles and non-road construction equipment. As a result of these measures, construction-related air quality effects would be minimal. The best management practices include the following:

- **Dust Suppression Techniques.** Construction crews would cover and/or treat disturbed areas where practicable with dust suppression techniques, including, but not limited to, soil binders, sprinkling, watering, and/or chemical stabilizer/suppressants. This would also include effectively controlling fugitive dust emissions by the application of water, presoaking, or other dust suppression techniques during clearing, grubbing, scraping, excavation, grading, cut-and-fill, and demolition activities.
- **Materials Transport.** Construction crews would cover or effectively wet dry materials transported off site and within the construction site to limit visible dust emissions. Construction crews would also limit vehicle travel speeds to minimize dust generation and remove tracked-out soil on area roadways when it extends 50 feet or more from the construction site and at the end of each workday.
- **Construction Equipment.** Construction crews would limit idling of construction equipment when the equipment is inactive and would properly maintain construction equipment in accordance with the manufacturer's specifications. Contractors would be encouraged to use electric-powered equipment and low volatile organic compound equipment when available.
- **Ground-Disturbing Activities.** Construction crews would phase ground-disturbing activities to the greatest extent possible to reduce the number of disturbed surfaces at any one time.
- **Traffic Management.** Construction crews would use proper traffic management during construction sequencing activities to mitigate traffic disruptions and potential adverse localized air quality effects. Traffic management activities may include providing traffic control, providing less congested routes for construction vehicles accessing the site, and restricting construction activities during hours of high traffic volumes on existing roadways. Contractors would be encouraged to use fugitive dust management, electric and zero emission vehicles and construction equipment, when they are available, cost-competitive, and meet operational needs.

6 Mitigation

Project construction and operation would comply with local, state, and federal regulations related to air quality. Potential effects on air quality would be minimized or avoided through planning, design, and application of required best management practices during construction and operation. ATP would include best management practices in construction contracts and would monitor contractor compliance to minimize air emissions and dust. Best management practices that may be implemented would include:

- wetting exposed soil, wheel washing of construction vehicles, and covering all transported loads to minimize dust and particulate emissions;
- covering and stabilizing disturbed soil by installing mulch or planting vegetation as soon as practicable after grading to reduce windblown particulates in the area;
- encouraging contractors to employ emissions-reduction technologies and practices for both on-road and off-road equipment and vehicles (e.g., retrofit equipment with diesel emission control technology, use ultra-low-sulfur diesel);
- implementing idling restrictions for construction trucks;
- planning routes and scheduling construction traffic, where practicable, to reduce additional congestion during peak travel periods and reduce carbon monoxide and nitrogen oxide emissions; and
- locating construction equipment and truck-staging zones away from air-quality-sensitive receptors.

The air pollutant and GHG emissions analyses demonstrated that no substantial air quality effects are expected to occur during Project construction and operation. As such, the Project would not be expected to cause or contribute to a violation of the NAAQS, and no long-term adverse effects on either local or regional air quality are anticipated. Therefore, no mitigation would be required. ATP would implement best management practices to minimize the potential for short-term air quality effects during the construction phase of the Project and would monitor contractor compliance with local, state, and federal statutes and regulations.

7 References

Austin Energy. 2023. Austin Energy Annual Report FY 23. https://austinenergy.com/-/media/project/websites/austinenergy/about/2023_annual_report.pdf?rev=b0f42e1f4dfe42608168bba715cc732a&sc_lang=en&hash=D00164C7BA7947EBE73F252334DA37CE.

Bureau of Transportation Statistics. 2023. Estimated U.S. Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel. Accessed September 20, 2023. https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and.

CAMPO. 2024a. *2045 Regional Transportation Plan*. Adopted May 4, 2020. Updated May 2024. Accessed July 2024. https://www.campotexas.org/regional-transportation-plans/2045-plan/.

CAMPO. 2024b. 2045 Regional Travel Demand Model.

CAPCOG. 2024. "Central Texas Air Quality." *Air Central Texas*. Accessed July 10, 2024. https://aircentraltexas.org/en/regional-air-quality/how-is-the-air-in-central-texas.

City of Austin. 2023. Austin is now the 10th Largest City in the U.S. Accessed April 24, 2024. https://www.austintexas.gov/news/austin-now-10th-largest-city-us.

City of Austin. 2024. "Discover the latest climate projections to understand how climate change will shape the city's future weather patterns." *Climate Projections for Austin*. Accessed July 12, 2024. https://www.austintexas.gov/page/climate-projections-austin.

EPA. 2008. 8 Hour Ozone Flex Program, Austin-Round Rock Metropolitan Statistical Area. April. https://www.epa.gov/sites/production/files/2016-03/documents/flex-austin-round_rock.pdf.

EPA. 2023a. NAAQS Table. March 15. Accessed September 2, 2023. https://epa.gov/criteria-air-pollutants/naaqs-table.

EPA. 2023b. Inventory of U.S. Greenhouse Gas Emissions and Sinks: About the Inventory of Greenhouse Gas Emissions and Sinks. November 8. Accessed December 4, 2023. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

EPA. 2023c. AirData Air Quality Monitors. Accessed September 27, 2023. https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=5f239fd3e72f424f98ef3d5def547eb5&extent=-146.2334,13.1913,-46.3896,56.5319.

EPA. 2023d. Climate Change Indicators: U.S. Greenhouse Gas Emissions. Accessed November 13, 2023. https://www.epa.gov/climate-indicators/climate-change-indicators-us-greenhouse-gas-emissions.

EPA. 2023e. "Sources of Greenhouse Gas Emissions." *Greenhouse Gas Emissions*. November 16. Accessed January 1, 2024. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

EPA. 2024a. Implementing the Final Rule to Strengthen the National Air Quality Health Standard for Particulate Matter – Clean Air Act Permitting, Air Quality Designations, and State Planning Requirements. https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-implementation-fact-sheet.pdf.

EPA. 2024b. "Monitor Values Report." *Outdoor Air Quality Data*. Accessed April 25, 2024. https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.

FHWA. 2023. "2023 FHWA Forecasts of Vehicle Miles Traveled (VMT)." Special Tabulations. July 27. Accessed April 17, 2024. https://www.fhwa.dot.gov/policyinformation/tables/vmt/vmt_forecast_sum.cfm.

FTA. 2023a. Capital Investment Grants Policy Guidance. January. Accessed September 2, 2023. https://www.transit.dot.gov/sites/fta.dot.gov/files/2023-01/CIG-Policy-Guidance-January-2023.pdf.

FTA. 2023b. New Starts Templates Part 1. September 18. Accessed December 4, 2023. https://www.transit.dot.gov/funding/grant-programs/capital-investments/new-starts-templates-part-1.

FTA. 2024. *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment*. FTA Report No. 0263. Prepared by John A. Volpe, National Transportation Systems Center. April. https://www.regulations.gov/document/FTA-2023-0006-0009.

NOAA. 2021. Annual 2020 Global Climate Report. National Centers for Environmental Information. January 2021. Accessed September 25, 2023. https://www.ncdc.noaa.gov/sotc/global/202013.

NOAA. 2023. "2022 was world's 6th-warmest year on record." January 12. Accessed September 25, 2023. https://www.noaa.gov/news/2022-was-worlds-6th-warmest-year-on-record.

Office of the Texas State Climatologist. 2021. *Assessment of Historic and Future Trends of Extreme Weather in Texas, 1900-2036: 2021 Update*. Texas A&M University. October 7. Accessed September 13, 2023. https://climatexas.tamu.edu/files/ClimateReport-1900to2036-2021Update.

TCEQ. 2023a. Ozone: The Facts. June 29. Accessed September 27, 2023. https://www.tceq.texas.gov/airquality/monops/ozonefacts.html.

TCEQ. 2023b. Air Quality and Monitoring, Ambient Air Monitoring and Interactive Monitoring Map. Accessed September 26, 2023. https://www.tceq.texas.gov/airquality/monops/air-mon.

TCEQ 2024. Sources of Air Emissions. Accessed April 16, 2024. https://www.tceq.texas.gov/airquality/areasource.

TxDOT. 2022. *Roadway Inventory Annual Reports*. Accessed July 31, 2024. https://ftp.txdot.gov/pub/txdot-info/tpp/roadway-inventory/2022.pdf.

TxDOT. 2024. Optimize System Performance. Accessed April 15, 2024. https://www.txdot.gov/data-maps/performance-dashboard/optimize-system-performance.html#:~:text=According%20to%20the%20Texas%20Demographic%20Center%2C%20our%20metro,Clear%20Lanes%20initiative%20to%20help%20provide%20congestion%20relief.

United Nations. n.d. "What Is Climate Change?" *Climate Action*. Accessed January 9, 2024. https://www.un.org/en/climatechange/what-is-climate-change.

U.S. Census Bureau. 2023. Quick Facts: Hays County, Texas; Bastrop County, Texas; Caldwell County, Texas; Williamson County, Texas; Travis County, Texas; Austin city, Texas. Accessed September 14, 2023. https://www.census.gov/quickfacts/fact/table/hayscountytexas,bastropcountytexas,caldwellcountytexas,williamsoncountytexas,traviscountytexas,austincitytexas/PST045221.

U.S. Climate Data. 2023. Climate Austin Texas. Accessed September 27, 2023. https://www.usclimatedata.com/climate/austin/texas/united-states/ustx2742.

UT-City Climate CoLab. 2024. Austin Future Climate: Climate Projections for the City of Austin 2024 Technical Report. June. Accessed July 10, 2024. https://www.austintexas.gov/sites/default/files/files/Sustainability/Climate/UTCCC%20Austin%20Future%20Climate%20Report_2024-06-03_V1p9.pdf.

Attachment A. Air Quality Emissions Calculations